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ABSTRACT

This document presents an outline for a 135-hour course designed to help students become employable and provide them with the skills, knowledge, attitudes, and values necessary for performing the required services in automotive tune up and performance. Such services are critical and must be exact to meet Federal Emission Control Standards. The course involves an orientation to the world of work together with an in depth study of trouble shooting components of engine tune-up using electronic testing equipment. Fuel metering, plus timing and emission control system maintenance are also covered. The behavioral objectives and performance standards necessary for a person to become an automotive tune up and performance mechanic are specified. A twelve item bibliography and a Quinmester post test sample are included. (KP)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-37

Course Outline
AUTOMOTIVE MECHANICS 3 - 9047
(Automotive Tune-Up and Performance)
Department 48 - Quin 9047.02

CE001 411

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

ED 092712

DADE COUNTY PUBLIC SCHOOLS
1450 NORTHEAST SECOND AVENUE
MIAMI, FLORIDA 33132

Course Outline

AUTOMOTIVE MECHANICS 3 - 9047
(Automotive Tune-Up and Performance)

Department 48 - Quin 9047.02

county office of

VOCATIONAL AND ADULT EDUCATION

THE SCHOOL BOARD OF DADE COUNTY

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Dr. Ben Sheppard

Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

February, 1973

Published by the School Board of Dade County

Course Description

9047	48	9047.02	Automotive Tune-Up and Performance
State Category Number	County Dept. Number	County Course Number	Course Title

A complete course in automotive engine tune-up. The student will be given an in/depth study of trouble shooting components using electronic testing equipment. Fuel metering, timing and emission control system maintenance will be performed in a shop environment which simulates industry. This is a two or three quinmester credit course.

Indicators of Success: Prior to entry into this course, the vocational student will display mastery of the skills indicated in Automotive Fuel and Carburetion.

Clock Hours: 135

PREFACE

The following quinmester course outline is a guide to help students become employable with the skills, knowledge, attitudes and values necessary for performing the required services - these services are critical and must be exact to meet Federal Emission Control Standards.

The course is designed as a foundation course for the automotive engine mechanic. This outline consists of five blocks of instruction, which are subdivided into several units each. This course is 135 hours in length.

Indicators for success in this course are: the student should have an eighth grade equivalency score in reading comprehension, arithmetic fundamentals, and mechanical aptitudes.

Instruction will consist of demonstrations, lectures, group discussions, audio-visual aids and resource people from industry. Instruction will be flexible to meet individual needs and abilities.

The bibliography appearing on the last page of this outline lists several basic references along with supplementary references and audiovisual aids.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Curriculum Materials Service, and has been approved by the Dade County Vocational Curriculum Committee.

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with Suggested Hourly Breakdown

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Student Benefits	1
Student Responsibilities	1
II. SERVICE TOOLS, EQUIPMENT AND MATERIALS (9 Hours)	
Hand Tool Kit	1
Tune-Up and Diagnostic Equipment	1
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GOALS

The student must be able to demonstrate:

1. The skills and knowledge required to perform maintenance, service and repairs on the automotive engine and its related systems.

2. The ability for accuracy and precision when trouble shooting and making a diagnosis of the automotive engine and its related systems.

3. Positive attitudes regarding the value and dignity of work.

4. Pride and respect of craftsmanship for this occupational field.

5. Safe work habits and proper shop behavior to guard against accidents.

6. An incentive to continue with more advanced training within this occupational field.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - ORIENTATION

The student must be able to:

1. Develop an understanding for opportunities that are available for careers in automotive mechanical occupations.
2. State what will be expected of him as an automotive engine mechanic.
3. Develop understanding, knowledge, and skills which will prepare him for a safe working life.
4. Demonstrate an understanding of shop organization, safety rules and regulations.
5. Demonstrate pride and respect for craftsmanship.
6. Evidence understanding and acceptance of his own duties and responsibilities.

BLOCK II - SERVICE TOOLS, EQUIPMENT AND MATERIALS

The student must be able to:

1. Define the general types of tools and their use.
2. To effectively select and use the applicable tools and perform the bench skills in the proper manner.
3. Demonstrate the proper care and maintenance of tools and equipment.
4. Practice safety precautions in the use of tools and equipment.

BLOCK III - TUNE-UP AND PERFORMANCE

The student must be able to:

1. Describe orally or in written fashion the operating principles of the four-stroke-cycle engine.
2. Explain the related systems of the four-stroke-engine.
3. Perform maintenance service and repairs of the automotive engine and its related systems.
4. Develop the skills necessary for trouble-shooting and diagnosis of the automotive engine and its related systems.
5. Exhibit the ability to follow the proper procedure and specification when performing an engine tune-up.

BLOCK IV - VEHICLE EMISSION CONTROL SYSTEMS

The student must be able to:

1. Exhibit an understanding of the basic fundamentals of the emission control systems.
2. Perform maintenance, repair and service of the emission control systems within acceptable standards.

3. Exhibit the skills necessary for trouble-shooting and diagnosis of emission control systems.

BLOCK V - QUINMESTER POST-TEST

The student must be able to:

1. Satisfactorily complete the quinmester post-test.

Course Outline

AUTOMOTIVE MECHANICS 3 - 9047
(Automotive Tune-Up and Performance)

Department 48 - Quin 9047.02

I. ORIENTATION

A. Objectives of the Course
1. Standards
2. Methods of evaluation
a. Written tests
b. Oral
c. Manipulation
d. Diagnosis and job performance
3. Teaching methods

B. Student Benefits
1. Opportunities for employment
a. Scope of the trade
b. Job opportunities
2. Qualifications for employment
a. Job competency
b. Pride of workmanship
c. Attitude
d. Dependability
e. Trade certificate
f. Foundation for more education and training
g. Experience

C. Student Responsibilities
1. School policies and expenses
2. Safety regulations
3. Shop rules and procedures
a. Care of hand tools
b. Use and care of equipment
c. Reporting defective equipment
d. Reporting loss of equipment
e. Materials and supplies
f. Housekeeping
g. Employee-employer relations
h. Employee-customer relations

II. SERVICE TOOLS, EQUIPMENT AND MATERIALS

A. Hand Tool Kit

B. Tune-up and Diagnostic Equipment
1. Oscilloscope
2. Exhaust analyzer
3. Emission analyzer
4. Tachometer and dwell meters
5. Volt-amp tester

a. Hydrometer
b. Battery post adaptor
6. Starter battery tester
7. Distributor tester
8. Timing light

III. TUNE-UP AND PERFORMANCE

A. Review of Internal Combustion Engine Fundamentals
1. Four stroke cycle
2. Compression ration
3. Compression pressures
4. Valves and camshaft function
5. Valve overlap

B. Conditions affecting Engine Performance
1. Mechanical conditions
a. Compression
b. Intake leak
c. Valve adjustment
d. Clogged air filter
2. Exhaust system
a. Collapsed exhaust pipe
b. Clogged muffler
3. Electrical system conditions
a. Spark plugs
b. Vacuum advance
c. Centrifugal advance
d. Timing
4. Sources of specifications
5. Compression test
a. Purpose of the test
b. How to make the test
(1) Wet test
(2) Dry test
c. Interpretation of test results
d. Specifications
6. Cylinder leakage test
a. Purpose of test
b. How to make test
c. Specifications
7. Cranking vacuum test

C. Spark Plug Servicing
1. Types of plugs used
a. Regular
b. Cold plug
c. Hot plug
d. Resistor
3. Heat range identification

2. Analyze plug condition
   a. Oil-fouled
   b. Gas-fouled
   c. Normal
   d. Plug glazing
3. Service the plug
   a. Cleaning
   b. Filing
   c. Re-gapping
4. Specifications
   a. Gap
   b. Type
5. Factors affecting plug performance
   a. Gap condition
   b. Reverse polarity
   c. Crossfiring in the secondary wires
   d. Faulty fuel system
   e. Faulty ignition system
   f. Oil pumping
   g. Intake manifold leak

D. Ignition Circuit
1. Function of the ignition circuit
   a. Primary circuit
   b. Secondary circuit
2. Primary system components
   a. Battery
   b. Ammeter or light
   c. Ignition switch
   d. Primary coil winding
   e. Contact points
   f. Condenser
   g. Primary wire harness
   h. Ground wires
3. Secondary system components
   a. Distribution cap and rotor
   b. Spark plugs
   c. Secondary wires
   d. Secondary coil windings
4. Function and operation of primary units
   a. Contact points
      (1) Dwell
      (2) Relationship of point gap to dwell angle
      (3) Relationship of point dwell to ignition timing
   b. Condenser
      (1) Resistance of test
      (2) Capacity test
      (3) Leakage test
   c. Coil
5. Function and operation of secondary units
   a. Coil
   b. Secondary wire
      (1) Resistor wire
      (2) Copper wire

c. Distributor cap and rotor
d. Transistor ignition system
e. Theory of operation
f. Types of systems
g. Advantages and disadvantages
h. Test procedures and precautions

E. Distributor Construction and Operation
1. Mechanical advance
2. Vacuum advance
3. Combined mechanical and vacuum advance
4. Distributor timing
a. Manufacturers' specifications
b. Allowable limits
5. Effect of distributor wear on ignition points
a. Bushings
b. Breaker plate
c. Contact set rubbing block
d. Breaker cam
6. Factors affecting point life
a. Condenser
b. Charging circuits
c. Moisture
d. Over lubrication
e. Misalignment

F. Testing Procedures - Tune-Up
1. Engine mechanical conditions tests
a. Compression test
b. Cylinder leakage test
c. Cranking vacuum test
2. Battery testing
a. Visual testing
b. Light-load test
c. High-rate discharge test
d. Hydrometer test
3. Starter testing
a. Starter amperage draw test
b. Cable and switches test
c. Cranking voltage test
4. Distributor testing
a. Dwell test
b. Dwell variation
c. Distributor resistance
d. Advance test
e. Timing
f. Electronic Ign distributor
f. Dual Ign point distributor
5. Primary system testing
a. Visual inspection
b. Ballast resistor test
c. Primary circuit resistance test
6. Secondary system testing
a. Visual inspection

b. Polarity
c. Available voltage test
d. Insulation test
e. Resistance test
f. Engine analysis with the scope

7. Charging system testing
   a. Visual inspection
   b. Circuit resistance test
   c. Voltage control test
   d. Current output test
8. Fuel system tests
   a. Visual inspection
   b. Pressure test
   c. Volume test
   d. Hot idle adjustment
   e. Fast idle speed
   f. Throttle linkage-wide open position
   g. Accelerator pump action
   h. Choke unloader
   i. Choke operation and setting
9. Mechanical service
   a. Tighten bolts on
      (1) Intake manifold
      (2) Exhaust manifold
      (3) Carburetor base
      (4) Carburetor cover
      (5) Fuel pump mounting flange
10. Inspect condition of:
   a. Cooling system and hoses
   b. Fuel system filters
   c. Fan belts
   d. P.C.V. Valve
   e. Manifold heat-control valve
11. Service questions when diagnosing
   a. How long has this condition existed
   b. When does it occur
      (1) Under acceleration
      (2) Cruising - normal road speeds
      (3) When hot
      (4) When cold
      (5) On a hard pull
      (6) De-Acceleration
   c. Have you had any work done recently?
   d. How long has it been since your points, plugs, air-cleaner, etc. have been changed?
   e. Road test-to determine specific operational malfunction

IV. VEHICLE EMISSION CONTROL SYSTEMS

A. Electronic Spark Control System
   1. Description and operation
      a. Solenoid vacuum valve
      b. Vacuum system

c. Electric system
d. Temperature switch
e. Speed sensor
f. Electronic amplifier

2. Diagnosis and testing
   a. Vacuum system check
   b. Electrical system check
   c. Power testing in hot circuit
   d. Temperature switch test
   e. Speed sensor test
   f. Vacuum valve electrical test

B. Transmission Regulated Spark Control System
   1. Description and operation
      a. Solenoid vacuum valve
      b. Vacuum system
      c. Electric circuit
      d. Temperature switch
      e. Transmission switch and ground
   2. Diagnosis and testing
      a. Manual transmission
      b. Automatic transmission
      c. Vacuum system check
      d. Electric system check
      e. Temperature switch and hot circuit check
         (1) Continuity test
         (2) Testing for open circuit
      f. Vacuum valve electrical test

C. The Improved Combustion System
   1. Inlet air temperature regulation
      a. Duct and valve assembly (thermostat operated)
      b. Temperature sensitive air-bleed valve
   2. Carburetor design features
      a. Idle limiter caps
      b. Idle speed throttle solenoid
      c. Choke pull down system
      d. Deceleration valve
   3. Distributor controls
      a. Dual-diaphragm vacuum advance mechanism
      b. Distribution vacuum control valve
      c. Spark delay valve

D. Crankcase Ventilation System
   1. Closed crankcase ventilating system
   2. PCV Valve-positive crankcase valve

E. Vapor Saver System
   1. Charcoal canister
   2. Limiting valve
   3. Pressure-vacuum fuel filler cap

F. Air Injection Exhaust Emission Control System
   1. Required essentials of combustion
      a. Fuel or unburned hydrocarbons in the exhaust system
      b. Heat-electrical spark--or the heat of the exhaust gases as they leave the combustion chamber
      c. Oxygen - as supplied by the air pump to the exhaust ports
   2. The air supply pump
      a. Air by-pass valve
      b. Check valve and air manifold
   3. Servicing air injection system
      a. Air supply pump service
      b. Relief valve replacement
      c. Relief valve pressure setting
      d. Centrifugal filter fan replacement

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A P P E N D I X

Quinmester Post-Test Sample

Quinmester Post-Test

Name _____ Date _____ Score _____

Multiple Choice Test Items

Each statement needs a word, a figure, or a phrase to make it correct. Only one of the choices listed is correct. Place the number of the choice you make in the space provided at the left edge of the sheet.

___ 1. A four-cycle engine camshaft used on domestic cars has a cam lobe for each valve and turns at:

1. Twice crankshaft speed
2. Same speed as the camshaft
3. Half crankshaft speed
4. Half ignition distributor speed

___ 2. The most common causes of burned engine valves is:

1. An overheated engine and fouled spark plugs
2. Improper valve timing and rich fuel mixture
3. Improper valve clearance and sticking valves
4. Low oil pressure and dirty air cleaner

___ 3. Valve overlap would be best described as:

1. The angle of crankshaft rotation through which both intake and exhaust valve is open
2. The amount of valve margin that overlaps the valve seat
3. The ratio between the length of the valve stem and the diameter of the valve head
4. The number of degrees before T.D.C. that intake valve closes

___ 4. If the timing chain stretches due to wear:

1. Compression will increase because the valves will stay closed longer
2. Detonation will be caused by early timing
3. Hydraulic valve lifters will get noisy because of lack of oil
4. Valve timing will be late and cause a loss of power

___ 5. Engine valves are closed by:

1. Camshaft pressure
2. Valve lifter pressure
3. Spring Pressure
4. Pushrod pressure

___ 6. At T.D.C. at the end of the exhaust stroke:

1. Both valves are opened
2. Only the exhaust valve is opened
3. Only the intake valve is opened
4. None of the above

___ 7. To use the engine compression tester:

1. Remove the carburetor
2. Remove the spark plugs
3. Remove the distributor
4. All of the above

___ 8. The manifold heat-control valve is located in the:

1. Intake manifold
2. Carburetor
3. Exhaust manifold
4. Cylinder head

___ 9. The ignition coil is capable of building secondary up to about:

1. 28,000 volts
2. 280 volts
3. 280,000 volts
4. 28 volts

___ 10. Continuous detonation will:

1. Increase crankcase dilution
2. Damage the pistons
3. Cause a rich mixture
4. Affect water pump operation

___ 11. The cam angle is the number of degrees that the distributor shaft rotates while the:

1. Points are closed
2. Points are open
3. No. 1 plug fires
4. No. 1 piston comes up on compression

___ 12. The centrifugal spark advance mechanism is controlled by:

1. Manifold vacuum
2. Engine speed
3. Throttle position
4. Engine Temperature

___ 13. When timing an engine with the timing light you notice that the timing advances as engine speed is increased slowly, but a sudden acceleration causes the spark to retard momentarily and then advances. Your diagnosis is:

1. The distributor cam sticks momentarily and should be lubricated
2. The vacuum advance is leaking and should be replaced
3. The rotor is binding inside the distributor cap and should be replaced
4. This is a natural condition and should not be tampered with

___ 14. The main purpose of the condenser is to protect the points and produce:

1. Quick magnetic field collapse
2. High voltage on points
3. High resistance at plugs
4. Low voltage in the primary

___ 15. Available voltage refers to the:

1. Voltage required to fire the plugs
2. Voltage drop in the secondary wires
3. Maximum secondary voltage
4. Voltage at the primary coil terminal

___ 16. The ballast resistor:

1. Surpresses static in radio and T.V.
2. Is part of the secondary circuit
3. Is in the spark plug
4. Controls voltage in the primary

___ 17. High voltage to fire the plugs is produced in the secondary coil winding during:

1. Magnetic buildup
2. Time points are closed
3. Resistor action
4. Magnetic collapse

___ 18. Ignition occurs when the:

1. Points just open
2. Points just close
3. Coil saturates
4. Condenser discharges

___ 19. Reversed coil polarity can be detected with a:

1. Dwellmeter
2. Voltmeter
3. Ammeter
4. Ohmmeter

___ 20. The function of the manifold heat control is to:

1. Preheat the liquid fuel from the fuel pump so it will vaporize more readily
2. By-pass exhaust heat around the intake manifold when the engine is cold
3. Regulate the amount of vacuum admitted to the climatic control thermostat
4. Vaporize moisture in the crankcase so the ventilating system will carry it off and prevent formation of sludge.

___ 21. A compression check indicates the condition of the engine:

1. Compression ratio and thermal efficient
2. Valves, rings, and bearings
3. Cylinder head gasket, rings and valves
4. Cooling system, ignition timing and mixture control

___ 22. Blue-gray smoke from the exhaust pipe indicates:

1. The carburetor out of adjustment
2. The air cleaner is plugged
3. Oil entering the combustion chamber
4. Dirty oil needs changing

___ 23. Detonation can be caused by:

1. Cold plugs
2. Early timing
3. Shorted ballast resistor
4. High Octane fuel

___ 24. Problem-engine cranks well and starts immediately, but dies as soon as the starter button is released. What is your diagnosis:

1. Trouble in the secondary circuit
2. Trouble in the starter motor circuit
3. Trouble in the fuel system
4. Trouble in the primary circuit

___ 25. Before setting carbon monoxide and air/fuel ratio-on an engine equipped with an air pump:

1. Close P CV valve
2. Disconnect carburetor vacuum line
3. Disconnect outlet hose of the check valve
4. None of these

___ 26. The greatest source for the release of unburned hydrocarbons into the atmosphere is the:

1. Crankcase
2. Carburetor
3. Exhaust
4. Fuel tank

___ 27. During deceleration the (by-pass valve) to prevent backfire- diverts the air from the pump to the:

1. Air cleaner
2. Atmosphere
3. Exhaust
4. Crankcase

___ 28. In the heated inlet air system when the inlet air to the carburetor is lower than 100°F, the valve door is:

1. Closed to underhood air
2. Open to underhood air
3. Closed to air pump outlet
4. Open to air pump outlet

___ 29. Valve clearance should be checked during routine tune-up:

1. Before checking compression
2. After checking compression
3. After the carburetor is adjusted
4. None of these

___ 30. The specific gravity of a fully charged battery is:

1. 1.110-1.130
2. 1.260-1.280
3. 1.170-1.190
4. None of these

___ 31. During a battery capacity test, the resistance is to be held for only:

1. One minute
2. 30 seconds
3. 15 seconds
4. None of these

___ 32. If the breaker point gap is increased, the dwell will:

1. Be increased
2. Be decreased
3. Not change
4. None of these

___ 33. Breaker point misalignment should be corrected by:

1. Bending the breaker arm
2. Replacing the pivot
3. Bending the stationary breaker point bracket
4. Replacing the distributor plate

___ 34. Available high-tension voltage is checked by:

1. Removing the coil
2. Removing the resistor
3. Removing a spark plug wire and measuring the voltage spike
4. Shorting out a spark plug

___ 35. The throttle stop solenoid on emission control systems is used to:

1. Prevent after running when ignition is turned off
2. Prevent timing from changing
3. Control the choke valve
4. Control the power valve

___ 36. Chrysler's new electronic ignition system eliminates the need for:

1. Breaker points
2. Dual ballast, resistor
3. Special distributor
4. Standard ignition coil

___ 37. What is the average resistance per foot of secondary resistance cable:

1. 500 to 1,000 ohms
2. 3,000 to 5,000 ohms
3. 8,000 to 10,000 ohms
4. 12,000 to 15,000 ohms

___ 38. Gasoline, particularly the unburned gasoline that shows up in an engine tailpipe is known as:

1. C O
2. H_2O
3. H C
4. CO_2

___ 39. The infra-red tester can be used to:

1. Check battery state of charge
2. Check polarity
3. Check timing advance rate
4. Check PCV system

ANSWER KEY TO QUINMESTER POST-TEST

1. 3
2. 3
3. 1
4. 4
5. 3
6. 1
7. 2
8. 3
9. 1
10. 2
11. 2
12. 2
13. 4
14. 1
15. 3
16. 4
17. 4
18. 1
19. 2
20. 2
21. 3
22. 3
23. 2
24. 4
25. 3
26. 3
27. 2
28. 1
29. 2
30. 2
31. 3
32. 2
33. 3
34. 3
35. 1
36. 1
37. 2
38. 3
39. 4